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WILDLIFE MANAGEMENT
AND IMPACT
INFORMATION SYSTEM

A BRIEFING ON THE

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM *

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BY

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8-25-81

*Introduction to Habitat Capability Models and the Goshawk Model were added on 19 January 1982.

INFORMATION NEEDED FOR LAND AND RESOURCE MANAGEMENT DECISIONS

LAND AND RESOURCE CAPABILITIES

The physical and biological capabilities of wildland resource ecosystems to produce a mix of resources, and the tradeoffs involved in managing for certain resources over others.

ECONOMICS

The costs and benefits involved in allocating scarce land, people, and financial resources among competing uses, including opportunity and external costs and benefits and equitability in the distribution of those costs and benefits.

SOCIO-POLITICS

The attitudes and concerns of various publics and society as a whole about resource goals, management costs and tradeoffs, appropriate technologies, and other relevant issues.

There are three principal kinds of information that influence resource management decisions: 1) the physical and biological capability of wildland ecosystems, 2) economic considerations, and 3) socio-political issues. In relatively few cases are the decisions based on the desired amount or quality of information on all three issues. Economic considerations are often dominated by marketed resources with little attention given to non-commodity resources or externalities. Socio-political issues are usually laden with conflicting emotions, making the search not for the "right" solution, but for the best compromise over a very short planning horizon. And, unfortunately, the weakest set of information provided to a decision-maker is often the biological capability of the land and the consequences of alternative management courses. This is especially true with regard to wildlife and fish resources.

To better fulfill the public trust for wildlife and fish stewardship we must improve our abilities to provide timely, accurate, and relevant information on wildlife and fish resources to resource decision-makers. A concerted and unified effort by all agencies and institutions seriously concerned with land, water, wildlife and fish is needed to ensure: 1) a systematic and consistent organization of data collection and management, 2) consistent application of habitat evaluation technologies, and 3) the meaningful integration of wildlife and fish information into resource management decision processes. This is the intent and purpose of the California Wildlife and Fish Habitat Relationships Program.

It must provide predictive capabilities for projecting the occurrence and response of all wildlife species to habitat change, with special attention to species selected for management emphasis because they are threatened, endangered, sensitive, game, commercial, or of special interest. It must include up-to-date information on locations and abundances of rare elements of the state's fauna and their habitats. And, above all it must make such information readily available to everyone involved in resource decisions.

Putting such an information system together will not be easy nor enthusiastically endorsed by all wildlife practitioners. Much of the information that goes in will be hypothesis at best, pure speculation at worst. But, in the game of resource management, if you want to ride the bench just say you don't know enough to play. At stake is the full integration of wildlife into resource decisions. All resource agencies, institutions, and concerned publics have a role in building the system because no one group has all the responsibility, expertise, money, or personnel to do the job.

In California nine organizations are working together to integrate components such as the California Natural Diversity Data Base, Wildlife Habitat Relationships, Habitat Suitability Modelling, habitat inventory and monitoring, and automated data processing into a wildlife information system for more effective wildlife planning.

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM

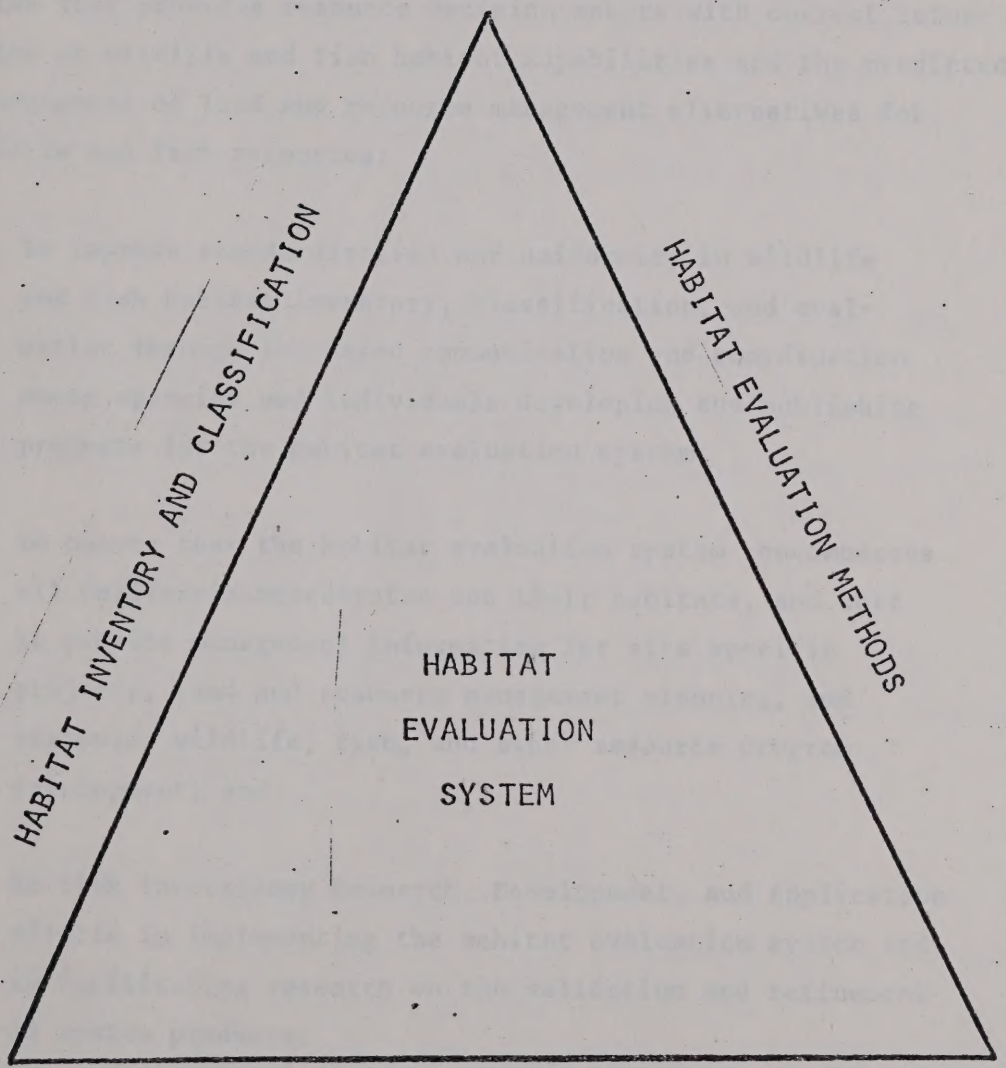
CALIFORNIA'S WILDLFE AND FISH RESOURCES *

FISH:	MARINE	SPP.
	ANADROMOUS	SPP.
	INLAND	SPP.
AMPHIBIANS		49 SPP.
REPTILES		75 SPP.
BIRDS		365 SPP.
MAMMALS		187 SPP.
TOTAL FISH		SPP.
TOTAL WILDLIFE		676 SPP.

* INCLUDES ALL RESIDENTS AND REGULAR MIGRANTS, BUT EXCLUDES ACCIDENTAL VISITORS AND ENTIRELY PELAGIC MARINE SPECIES

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM

WILDLIFE HABITAT EVALUATION SYSTEM



SPECIES-HABITAT RELATIONSHIPS MODELS

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM

GOALS

To develop and implement a wildlife and fish habitat evaluation system that provides resource decision-makers with current information on wildlife and fish habitat capabilities and the predicted consequences of land and resource management alternatives for wildlife and fish resources:

To improve standardization and uniformity in wildlife and fish habitat inventory, classification, and evaluation through increased communication and coordination among agencies and individuals developing and publishing products for the habitat evaluation system;

To ensure that the habitat evaluation system encompasses all California vertebrates and their habitats, and that it provide management information for site specific projects, land and resource management planning, and statewide wildlife, fish, and other resource program development; and

To link interagency Research, Development, and Application efforts in implementing the habitat evaluation system and in facilitating research on the validation and refinement of system products.

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM

PROGRAM ORGANIZATION

Program leadership is jointly vested in the California Department of Fish and Game, Wildlife Management Branch, and the USDA Forest Service, Pacific Southwest Region, Wildlife and Fisheries Staff. This is in recognition of the Forest Service's pioneering role in developing the Program and the Department's new role in expanding it to cover the entire State.

The California Interagency Wildlife Task Group for Inventory and Classification serves the Program in an advisory role, proposing, reviewing, and assisting Program leaders in development and application of the Program's products. The Interagency Wildlife Task Group is open to all interested individuals and agencies. It is currently composed of representatives from:

USDA Forest Service, Pacific Southwest Region (Group Leader)
USDA Forest Service, Pacific Southwest Forest and Range Experiment Station
USDA Soil Conservation Service
USDI Bureau of Land Management
California Department of Fish and Game
California Department of Forestry
University of California, Department of Forestry and Resource Management
University of California, Cooperative Extension
University of California, Laboratory of Nuclear Medicine and Radiation Biology
Southern California Edison Co.
Pacific Gas and Electric Co.

Level 3: Species population related to the aggregate amount, capability, and distribution of suitable habitats for all population sub-groups (see Example 4); principal application in range capacity evaluations for management indicator species, e.g. production potential or viability.

Special Habitat Criteria:

Narrative and models of special habitat criteria in relationship to capability for all associated wildlife (see Example 5); principal application in management prescriptions and habitat evaluations for riparian, aspen groves, wet meadows, hardwood stands, etc..

Population and Habitat Management Guidelines:

Detailed literature review on species ecology and management, population and habitat management guidelines, and guidelines for management of associated resources (see Example 6); principal application for major species management programs, e.g. pronghorn, deer, bear, bighorn, etc. (Recovery plans for T&E species would fit this category).

HABITAT INVENTORY AND CLASSIFICATION

A system for inventory, classification, and management of information on wildlife and their habitats.

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM

HABITAT EVALUATION SYSTEM

SPECIES-HABITAT RELATIONSHIPS MODELS

Word, graphical, and mathematical models that relate species life requisites for reproduction, feeding, cover, water, and space to habitat variables for the purpose of predicting potential species occurrence and habitat capability.

PRODUCTS:

Species Note and Map:

Brief narrative description of species life history, habitat use, special habitat requirements, and distribution map (see Example 1);

Habitat Capability Models:

Level 1: Individual animals related to single habitat variables for reproduction, feeding, and cover (see Example 2); principal application to broad level planning and diversity analyses;

Level 2: Groups of individuals (e.g. breeding pairs, migratory bands) related to the set of all habitat variables needed within a home range or designated area (see Example 3); principal application in the evaluation of habitat capability for management indicator species;

124 Example 1 114

43

SPOTTED OWL B224

STRIX OCCIDENTALIS

43

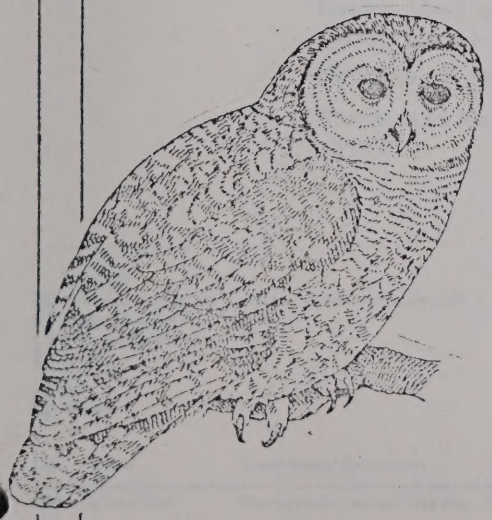
CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS SYSTEM

LEGEND

WINTER RANGE

SUMMER RANGE

YEAR ROUND



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31

SPOTTED OWL

FAMILY: STRIGIDAE ORDER: STRIGIFORMES CLASS: AVES

STATUS: No official listed status. Fairly common permanent resident in suitable habitat, with some seasonal movement downslope and upslope.

DISTRIBUTION/HABITAT: Breeds from ponderosa pine type upslope to lower elevation red fir forests (not above 7600 ft [2300 m]). Mixed conifer the optimum forest type on west slopes of the Sierra Nevada. Black oak in forest canopy enhances habitat suitability (G. Gould, pers. commun.). Stands of large trees, typically with some understory trees combining to give much shade, considered important in breeding sites. Most or all records in pole to medium-sized trees are of young or other nonbreeding birds (N. Johnson, pers. commun.). In Oregon, Forsman *et al.* (1977) reported density about 12 times greater in old-growth forests than in second-growth forests.

SPECIAL HABITAT REQUIREMENTS: Water probably needed; large trees.

BREEDING: Breeds from early March to late June, with peak from mid-April to mid-June. Nests in tree hollows or occasionally on cliffs and abandoned raptor nests. Nests range in height from 30 to 50 ft (9.1 to 15 m). Clutch size from 1 to 4, with mean of 2.

TERRITORY/HOME RANGE: According to Gould (1974), territory size in conifer forests in the Sierra Nevada ranges from 100 to 340 acres (40 to 138 ha), with mean of 230 acres (93 ha), and home range size varies from 300 to 600 acres (121 to 242 ha), with mean of 450 acres (182 ha). In Oregon, Forsman (pers. commun.) found home ranges from 2270 to 3400 acres (920 to 1375 ha), with mean of 2910 acres (1177 ha), on the basis of 8 birds with radio transmitters. Adjacent birds overlapped 3 to 25 percent (mean 12 percent) in home ranges; members of pairs overlapped about 66 percent.

FOOD HABITS: Eats primarily small mammals, large insects, and small birds. Captures most of prey by search and pounce methods in forest canopy. Fully nocturnal.

OTHER: Until recently, considered rare throughout range. A study by Gould (1974), however, revealed fairly common in dense, coniferous forests at mid-elevations. Because of their solitary, nocturnal habits, rarely seen.

REFERENCES: Marshall 1942, Gould 1974, Jackman and Scott 1975, Forsman *et al.* 1977.

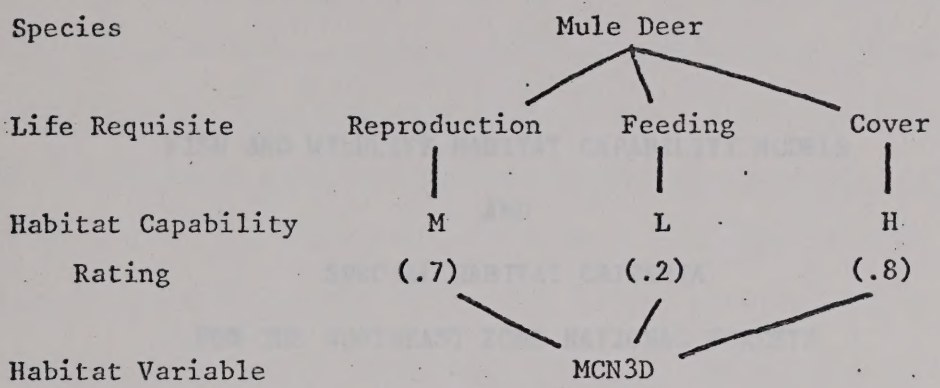
LEGEND
Optimum Habitat (1)
Suitable Habitat (2)
Marginal Habitat (3)
Spring
Summer
Fall
Winter

For key to this matrix, see *figure 2.*

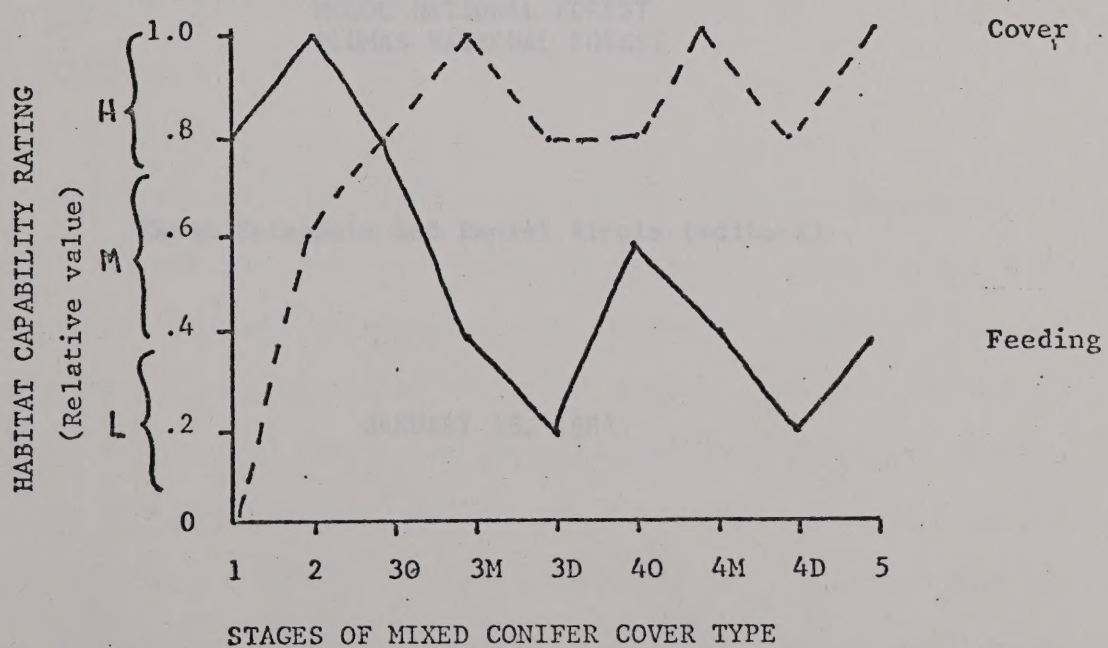
Species occurrence and utilization, by habitat stages

Code	Species	Special Habitat Requirements	Page	Function	Digger Pine-Oak	Chaparral	Ponderosa Pine	Black Oak Woodland	Mountain Meadow	Riparian Deciduous	Mixed Conifer	Jeffrey Pine	Red Fir
					1 2 3 3 3 4 4 4 A B C A B C	1 2 3	1 2 3 3 3 4 4 4 A B C A B C	1 2 3 3 4 4 A B A B	WD	L M H	1 2 3 3 3 4 4 4 A B C A B C	1 2 3 3 3 4 4 4 A B C A B C	1 2 3 3 3 4 4 4 A B C A B C
B068	Spotted Owl	Water probably needed; large trees	160	B									
	SENSITIVE			F									
				R									
				S									

Example 2. Habitat Capability Rating for life requisites of individuals as provided by single habitat variables.



Ratings are derived from relationships:



Example 3

FISH AND WILDLIFE HABITAT CAPABILITY MODELS

AND

SPECIAL HABITAT CRITERIA

FOR THE NORTHEAST ZONE NATIONAL FORESTS

LASSEN NATIONAL FOREST
MENDOCINO NATIONAL FOREST
MODOC NATIONAL FOREST
PLUMAS NATIONAL FOREST

Karen Shimamoto and Daniel Airola (editors)

JANUARY 15, 1981

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INTRODUCTION

by Hal Salwasser and Karen Shimamoto

Under National Forest Management Act (NFMA) planning regulations (36 CFR 219), fish and wildlife management indicator species are selected by each Forest for planning and management attention. These species will help guide land allocations and shape multiple-resource prescriptions in meeting legal requirements and local resource demand. To support this role each species must have a documented description of the habitat conditions needed to sustain it at different population levels. The minimum habitat conditions necessary for sustaining population viability are also required. The development of prescriptions to favor certain management indicator species also requires a description of habitat conditions associated with high population levels of each species. The descriptions of habitat conditions associated with different population levels are called Habitat Capability Models (HCM).

NFMA regulations mandate that each Forest maintain habitat conditions to support wildlife and fish populations at or above the abundance and distribution needed for long-term population viability. However, neither managers nor scientists fully know what kinds, amounts, and distribution of habitats are necessary to maintain population viability. Therefore, existing knowledge of species ecology and habitat needs must serve to describe the habitat conditions needed. Models (standards and criteria) must be formulated to describe in quantitative and qualitative terms the habitat conditions by which to judge existing and projected habitat resources.

Most of the HCMs address the habitat conditions required by individual reproductive units within wildlife and fish populations. This is because land management projects usually affect small part of populations such as a breeding pair, a family unit, a small group of breeding pairs, or a small group of family units before whole population changes are noticed. Total population abundance and distribution on the Forest can be projected by aggregating and mapping those land areas that provide capable, available, and suitable habitat for reproductive units of populations.

The HCMs do not address some aspects of population viability. Minimum to optimum distances between reproductive units and population size are two important attributes of viability that must be addressed for relevant species outside the HCMs.

Special Habitat Criteria were first developed by biologists on the Stanislaus National Forest as an extension of the HCM concept (Hurley et al 1981). While HCMs describe habitat conditions for individual management indicator species, the information in the Special Habitat Criteria models describes conditions necessary to maintain or optimize populations of fish and wildlife species closely associated with special habitats (riparian, aspen, snags, etc.).

HABITAT CAPABILITY MODELS

The following format was used in the construction of each habitat capability model.

Model Applicability

Life Stage(s) - Identify the appropriate life stages covered by the model e.g. egg, larval, fry, juvenile, adult, all

Season(s) - Identify the appropriate season(s) e.g. fall, winter, spring, summer

Geographic Area - The model may apply to the species' entire range. However, if regional differences in habitat use and preference occur, separate models may be appropriate.

Intended Application - Most models will be formulated with Forest planning in mind. Some models, however, may be detailed enough to apply to project work. Provide a clear statement of the intended use.

Expected Reliability - The following hierarchy was used:

Level 1 - Model predicts existing carrying capacity density with acceptable variance, i.e. 10-20%

Level 2 - Model habitat capability ratings directly correlate with density estimates

Level 3 - Model habitat capability ratings directly correlate with ratings of the same sites by species authorities

Level 4 - Model structure and outputs appear reasonable to species authorities

Level 5 - Model structure and outputs meet technical standards and appear reasonable to author(s), editor(s), and users.

Verification Status - The purpose of verification is to ensure that the model meets the expected reliability criteria and that it faithfully provides the intended outputs. Each step in verification depends on the expected reliability of the model. The following hierarchy was used:

1) Model is in draft.

2) Model reviewed by editor (the editor should check for conformance with model quality standards, sufficiency of documentation, and understandability).

3) Model reviewed by editor and users.

4) Model reviewed by species authority.

5) Model evaluated with sample data - apply the model with sample data sets which mimic various habitat conditions, e.g. high, medium, and low habitat capability. Evaluate model outputs as to how well they give a reasonable prediction of habitat conditions.

6) Model tested with field data - field data must be available to provide measurements of both habitat variables and indicators of habitat capability. The latter can range from ratings of habitat capability by species authorities to density estimates to actual densities. Statistical and sampling expertise is required to design and perform these tests.

Model variables were restricted to physical, chemical, or biological characteristics of habitats. Species population variables, such as birth rates and sex ratios, are not suitable due to high cost of measurement, difficulty of prediction, and dependency on other factors beyond habitat. The critical question answered was, "what environmental variable, when changed, will affect the capability of an area to support a management indicator species?"

Each of the identified habitat variables were combined with the others to produce a habitat capability model. Each variable has values with different implications for habitat capability. For example, the variable average tree canopy cover has a high habitat value for goshawks when it is between 40-60%. Each of the variables and its respective values were ranked according to habitat capability:

High: the values are related to the highest densities of the species; the values are preferred over other values;

Medium: the values are related to moderate densities of the species; the

values are required for the long-term viability of the population or reproductive unit of the population:

Low: the values are related to the lowest densities of the species; the values are denote marginal habitat capability for the species and would not be capable of supporting a viable population.

The variables were organized according to their importance in determining habitat capability and arrayed in rows under the headings high, medium, and low. An attempt was made to reduce redundant variables, retaining only those variables that are most practical to measure.

Documentation

As in model reliability and verification status, documentation for each model is in varying stages of completion. The levels of documentation are:

Level 1 - Literature references, written or personal communication, and the author's judgement are cited.

Level 2 - A narrative accompanies the model, summarizing why each variable was selected, how each variable is related to the species' habitat needs, and how habitat capability values were determined. This level also includes Level 1.

Level 3 - A narrative accompanies the model with documentation on the species ecology and habitat use. This information is related to

the habitat variables in the model. It involves preparing a species note with the following information:

I. Distribution, Abundance, and Seasonality

II. Specific Habitat Requirements

A. Feeding

B. Cover

C. Water

D. Reproduction

E. Pattern

III. Species Life History

A. Activity Patterns

B. Seasonal Movements/Migration

C. Home Range/Territory

D. Reproduction

E. Niche

This level also includes Levels 1 and 2.

Level 4 - The habitat variables are aggregated to develop a mathematical formulation of the model (U.S. Fish and Wildlife Service 1980). Assumptions and limitations to be used when applying the model are provided and the necessary steps to correctly use the math-

ematical model is documented. The latter includes how to collect data on model variables, how to treat that data as model inputs, and how to interpret habitat capability based on the data. This level includes levels 1, 2, and 3.

Because many initial species models will be developed from scant data, modelers will rely on experiential evidence and intuition to establish the model variables and relationships. Such models will have level 1 or 2 documentation. As model application and verification improve, habitat relationships can be more accurately represented and the models made more quantitative. Models with level 3 or 4 documentation are examples of species where more information is known and the models have been "calibrated" with real data.

Vegetation Types and Successional Stages

The vegetation types and successional stages used in the habitat capability models are consistent with the California Wildlife Habitat Relationships Program for the Northeast Interior Zone (Laudenslayer in prep), the Western Sierra Zone (Verner and Boss 1980) and the North Coast-Cascades Zone (Marcot 1979). For convenience, the codes used for successional stages are defined in Table 1.

Rating Overall Habitat Capability

For any given area of land, habitat capability ratings (high, medium, low) will be different for each habitat variable. This makes rating the overall

habitat capability difficult. Models for spotted owl and mule deer, have been developed to include a mathematical calculation of habitat capability where different ratings are quantitatively assessed and an overall capability index is mathematically calculated. The method for rating overall habitat capability for the other models, however, must be done using subjective biological judgement.

For such cases, the simplest approach is to assess the overall habitat capability rating in terms of a simple majority of variable ratings. For example, if three variables were rated as medium and one variable as high for bald eagle habitat, the overall rating could be considered medium.

In other situations, experience may justify identifying one or more variables as more important or possibly overriding other variables. Biologists should then weight these variables accordingly when determining overall habitat capability.

Table 1. Successional stage codes

Code	Definition
1	Barren/grass/forbs
2	Shrub/seedling/sapling; tree saplings <11" DBH
2a	<40% tree canopy closure
2b	40-70% tree canopy closure
2c	>70% tree canopy closure
3	Small sawtimber; 11-24" DBH
3a	<40% overstory canopy closure
3b	40-70% overstory canopy closure
3c	>70% overstory canopy closure
4	Medium to large sawtimber; >24" DBH
4a	<40% overstory canopy closure
4b	40-70% overstory canopy closure
4c	>70% overstory canopy closure
5	Two-storied stand; scattered overstory over a well-stocked understory (4a over 2c or 3c)

Literature Cited

Hurley, J. F., S. R. Robertson, S. R. Brougher, and A. M. Palmer. 1981. Wildlife habitat capability models and habitat quality criteria for the Western Sierra Nevada. Stanislaus National Forest. 56p.

Laudenslayer, Jr. W. F. (in prep) California wildlife habitat relationships program: northeast interior zone. Vol. 1 - Species/habitat matrix. USDA Forest Service Region 5.

Marcot, B.G. (ed). 1979. California wildlife habitat relationships program: North Coast-Cascades Zone. USDA Forest Service. Six Rivers National Forest.

US Fish and Wildlife Service. 1980. Habitat Evaluation Process. 103 ESM.

Verner, J. and A. A. Boss (Technical Coordinators). 1980. California wildlife and their habitats: western Sierra Nevada. USDA Forest Service. Gen. Tech. Rep., PSW-37, 439p.

GLOSSARY

Management Indicator Species - plant or animal species whose population parameters (presence, number, density, sex ratio, age structure, recruitment rates, mortality rates, or dispersal equilibria) can be used to show the effects of land and resource management practices and actions on other species, groups of species, or an ecosystem which is being treated as a management unit, or are species of sufficient importance that their status must be monitored for its own sake.

Habitat Capability - the ability of an area of land and/or water to produce wildlife, fish, or plant resources.

Population Viability - a viable population is capable of existing on a National Forest during the planning horizon under the set of environmental conditions anticipated (whether they be natural or man-influenced). Viability should be considered as an issue only for those species which may be subject to environmental changes sufficient to endanger their continued existence on the Forest.

GOSHAWK HABITAT CAPABILITY MODELS

FOR

NEST HABITAT AND NEST TERRITORY

Ernie Camilleri

Modoc National Forest
February 1981

GOSHAWK HABITAT CAPABILITY - NEST HABITAT

Acciptor gentilis

Life Form 11

Nesting	High	Med.	Low
Vegetation Type	White fir Douglas fir Red fir Ponderosa pine Jeffrey pine Lodgepole pine Mixed Conifer	Aspen Black oak Sugar pine Pacific madrone	Other Trees
Seral Stage	5, 4b, 4c	3b, 3c	4a
Ave. Canopy Closure	>60%	40-60%	30-40%
.1 Ac. or Larger Canopy Opening	2+ within stand	1 within stand	None present
Ave. Slope of Stand	0-25%	25-50%	>50%
Dist to Free Water	<.25 mi.	.25-1 mi.	>1 mile
Dist. to Natural Opening	<.25 mi.	.25-1 mi.	>1 mi.
Prey Plucking Sites	Topped trees, stumps, logs or large horizontal limbs below the canopy		
Nest Stand Size	40-100 ac.	30-40 ac.	20-30 ac.

GOSHAWK NESTING HABITAT CAPABILITY

Vegetation Type - Those types listed have all been used by nesting goshawks (Bauer 1974; Forsman 1980; Hall 1980; McGowan 1975; Newman 1978; Reynolds 1979; Shuster 1980;). Placement of these types into highly or moderately capable categories is based on incidents of nesting preference (McGowan 1975; Hall 1980; Reed pers. comm. 1981; Hubble pers. comm. 1979). This is my professional opinion and should be reviewed. Forsman (1980) suggests that density rather than tree species determines nesting habitat. For example, Shuster (1980) found nests in aspen and pine with consistently higher basal area values for aspen than pine in Colorado. However, aspen stands may rarely exceed the basal area values of surrounding conifers by a wide enough margin to afford a change in preference in California.

Seral Stage - These designations refer to sucessional stages used in the California Wildlife-Habitat Relationships Program for the Northeast Interior Zone. Stages 4 and 5 are considered highly capable because of the large tree component. Two storied stands were not considered significantly more capable than single storied stands (Hall 1980). A random sample of 20 nests in the Warners revealed 7 to be in single storied stands, the remaining in two storied stands. Three of 6 nests on the Inyo National Forest were in single storied stands (Hubble pers. comm. 1979).

Average Canopy Closure - Sixty-two nest sites on the Fremont National Forest had an average canopy closure of 60% (Forsman 1980). Fifty-nine nest sites in the Warners had no canopy closures less than 30% and only 2 were below 40%.

Canopy Openings - Hall (1980) found canopy closure at the nest tree to average 10% less than the associated stand. Shuster (1980) found all 20 nests he studied adjacent to a small opening in the canopy.

Average Slope of Stand - Reynolds (written comm. 1979) found the majority of 74 nests located on slopes 0 to 30%. All 59 nests in the Warners were in stands with less than 50% average slope, with 51 of these on slopes of 25% of less.

Distance to Free Water - Springs or small streams were usually contained in or immediately adjacent to nest sites (Reynolds 1979; Shuster 1980).

Distance to Natural Opening - Shuster (1980) reported a 1+ acre opening within .25 miles of the nest, for all of the nests he studied. A random sample of 25 nests in the Warners found 22 nests within .25 miles of a natural opening.

Prey Plucking Sites - The relative importance of this component is questionable for determining site capability, but it is used when available.

Nest Stand Size - Long search times for prey are dangerous when young are small (Reynolds 1979). Bird species richness was estimated to increase with stand size up to a maximum of 84 acres in the Blue Mountains of Oregon and Washington (Thomas et al. 1976). A 100 acre limit on stand size is suggested if the stand is consistent throughout in successional stage and vegetative composition. Reynolds (pers. comm. 1979) recommended leaving a

unharvested stand, 30 acres in size around nests, and that the stand not be entirely surrounded by a silvicultural treatment. Anderson (pers. comm. 1979) reported of incidents when stands less than 25 acres were left unharvested and no longer used by goshawks.

GOSHAWK HABITAT CAPABILITY - TERRITORY

Accipter gentilis

Life Form 11

Territory	High	Med.	Low
Nest Habitat Component (stands)	2 or more high capable sites	1 highly capable site, 1 or more medium capable sites	1 medium capable site, 1 or more low capable sites
Prey Base	High availability of large prey (e.g., hares and grouse		
Ave. Distance Between Nest Stands	0-.5 mi.	.5-2 mi.	>2 mi.
Habitat Diversity	>6 Plant Communities, & >3 Successional Stages <1 mi. radius from each nest site.	Same as high capability, except .5-2 mi. radius from each nest site.	Anything less than medium capability.
Disturbance	No logging or ORV use within .3 mi. of nest sites. March-June		

GOSHAWK TERRITORY HABITAT CAPABILITY

Nesting Habitat Component (Nest stands) - Reynolds (pers. comm. 1979) said the amount and quality of nesting habitat was probably the greatest limiting factor of nesting goshawk populations. According to Anderson (pers. comm. 1979), goshawks reoccupied 60% of the 80+ stands he studied on the Wallowa-Witman National Forest. Each territory should, therefore, contain at least 2 suitable nesting stands in either medium or high capability condition to optimize reoccupancy rates.

Prey Base - The availability of prey is probably the second most important factor affecting nesting goshawk densities. Goshawks prefer large prey (e.g., hares and grouse) but often rely on small prey (e.g., chickerees and robins) because large prey are not readily available (Reynolds 1978). Data on mean prey size taken in the Warners has not been collected, but of all the kills I have seen, large prey have been far more common in high capability territories.

Average Distance Between Nest Stands - Reynolds (pers. comm. 1979) believes that little to no overlap of hunting ranges occurs between adjacent pairs of nesting goshawks. If this is true, then high capability territories providing a greater density of large prey should result in a reduced hunting range and shorter distance between nesting pairs. In the Warners, many pairs have been found nesting within 1 mile of each other. This requires that alternate nest stands for each pair be less than 0.5 miles from the active nest.

If alternate nest stands of medium to high capability are provided as close as possible (<0.5 miles) to the active nest, the foraging range will be kept to a minimum and the reoccupancy rate will be optimized.

Habitat Diversity - Thomas et. al (1979) identified 7 plant communities and 4 successional stages used by goshawks for feeding. I believe that 6 or more plant communities and 3 or more successional stages within 1 mile of the nest site will maximize prey base diversity and in turn large prey density.

Disturbance - Goshawks are most sensitive to disturbance through the incubation period (Forsman 1980). Newman (1978) reported that the sight and sound of falling trees caused a nestling goshawk to retreat into the nest, stop feeding and make startled movements. In the Warners, goshawks have successfully fledged young when logging activity has been excluded within .3 miles of active nest sites.

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Example 6

Pronghorn Antelope Population and Habitat Management in the Northwestern Great Basin Environments

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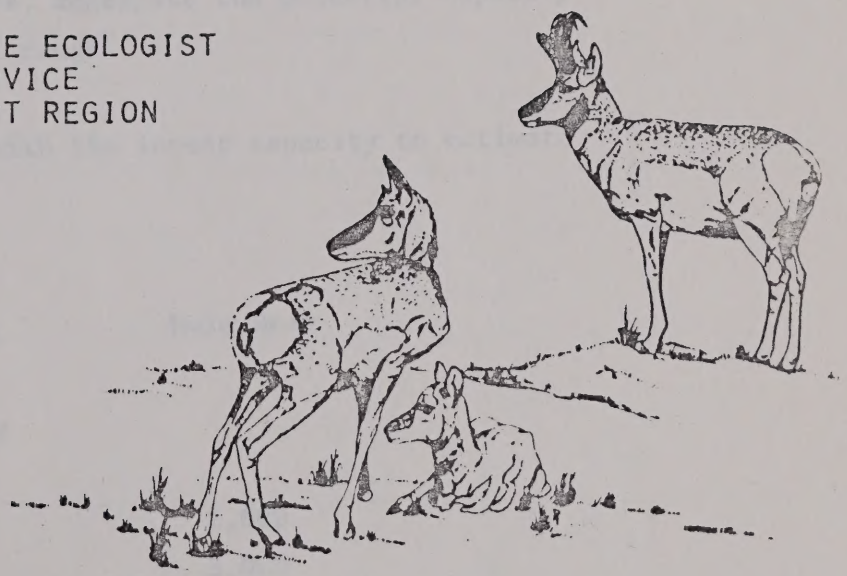

MARCH 1980

THE INTERSTATE ANTELOPE CONFERENCE GUIDELINES
CALIFORNIA DEPARTMENT OF FISH AND GAME
NEVADA DEPARTMENT OF WILDLIFE
OREGON DEPARTMENT OF FISH AND WILDLIFE
USDA, FOREST SERVICE
USDI, BUREAU OF LAND MANAGEMENT
NATIONAL PARK SERVICE
FISH AND WILDLIFE SERVICE

Example 4. A possible strategy for estimating population capacity based on habitat evaluations.

1. Delineate each potential seasonal habitat for sub-groups of the population, e.g. breeding pairs, migratory bands, wintering groups, etc.

2. Evaluate habitat capacity for each delineated habitat using appropriate seasonal and site specific Habitat Capability Models and yield tables.

3. For those habitat units accessible to the population through suitable travel corridors, aggregate the potential capacity of all units by seasonal range.

4. Use the seasonal range with the lowest capacity to estimate total range capacity:

Species	Mule Deer
Seasonal Range Capacity	
Winter	2,600
Spring/Fall	3,000
Summer	4,500
Total Estimated Capacity	2,600 (constrained by winter)

SPECIAL HABITAT CRITERIA

Example 5. MEADOWS

HABITAT VARIABLE	CAPABILITY		
	High	Medium	Low
SIZE (acres) (3,4)	> 15	2 - 15	< 2
SNAGS ALONG EDGE (no./acre)			
>12"dbh	1.0	0.7	0.4
10-12"dbh	0.5	0.3	0.2
6-10"dbh	1.5	1.0	0.6
total >6"dbh (5)	3.0	2.0	1.2
PERCENT OF TOTAL EDGE IN SIZE CLASS 3 OR 4 (4)	≥ 80	60	40
DENSITY OF SIZE CLASS 3 OR 4 IN EDGE (4)	B (40-70%)	C (>70%)	A (<40%)
WIDTH OF EDGE IN SIZE CLASS 3 OR 4 (ft.) (1)	≥ 100	50	25
LOGS DISTRIBUTED THROUGHOUT MEADOW (no./acre) (4)	> 4	2 - 4	< 2
DISTANCE FROM ROADS TO MEADOW EDGE (ft.) (1)	≥ 100	50	25
WATER (2)	Full time source of drinking water and sufficient ground water for wet or marsh vegetation.	Full time source of drinking water and some ground water to support wet vegetation.	Evidence of developable source of drinking water or evidence of ground water.
OTHER	Access roads closer than 100 ft. from the meadow edge may have adverse impacts on wildlife utilization.		

Note: 1. A meadow is defined here as an area dominated by either perennial sedges, rushes, and grasses (wet meadow) or perennial grasses and forbs (dry meadow) (b). Generally there are a few if any trees, and the area is not managed for timber production.

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PRODUCTS:

Habitat Classification:

Habitat Cover Type/Stage

Dominant vegetative cover types, e.g. MCN
Size or age class of dominant vegetation, e.g. 3
Canopy closure of dominant vegetation, e.g. D

for example MCN3D = dense canopy (70-100%), pole to small tree (6-24" dbh), stand of mixed conifers

Principal application in broad level planning and habitat evaluation for animal community diversity.

Specific Habitat Elements

Elements, such as snags, logs, seeps, mast, that enhance or are essential for habitat capability within a habitat cover type/stage; principal application in project work and management prescriptions.

Habitat Inventory:

Integrated: coordination with other resources in developing integrated site inventories and data bases

CNDDB: use DATABASE for inventory of rare elements

ASBI: use ASBI maps and updates for key habitats

Special inventories as needed to augment above

Habitat Data Management:

Work with CNDDB, other agencies, and other resources within agencies to develop common data base systems.

HABITAT EVALUATION METHODS

The general habitat evaluation strategy involves:

1. Delineate assessment area
2. Identify issues, concerns, and opportunities
3. Translate I,C,O's to goals for diversity and management indicator species
4. Determine level of resolution needed in inventory and analysis
5. Specify analytical methods to be used, e.g. models
6. Collect needed data, using existing data in data bases to the maximum extent possible
7. Perform evaluation analyses using above data and models to address existing and predicted capabilities and consequences for management indicator species and diversity

Technology and procedures for evaluating habitat capability and the consequences of management alternatives are being developed for three major decision-making levels:

PROGRAM LEVEL:

Very large area, e.g. state or Region
Small scale resolution, e.g. 1:125,000 to 1:1,000,000
LANDSAT data suitable for habitat inventory

PLANNING LEVEL:

Large planning area, e.g. .1 to 5 million acres
Medium scale resolution, e.g. 1:60,000 to 1:125,000
U2 Color Infrared/Color Photo/Field Reconnaisance for habitat inventory

PROJECT/SITE LEVEL:

Small planning area, e.g. project, up to 100,000 acres
Large scale resolution, e.g. 1:4,000 to 1:60,000
U2 Color Infrared/Color Photo/Field Sampling for habitat inventory

The USFWS HEP methodology is most appropriate for the project/site level. We need to integrate it into our system, and develop methodologies for the other levels as needed by cooperating agencies. The levels of resolution matrix for habitat evaluation illustrates the relative capabilities, costs, and benefits of combinations of species-habitat relationships models with the three decision-making levels (see Example 7).

Example 7. Levels of resolution matrix for habitat evaluation.

Wildlife Analysis Levels	Habitat Evaluation Levels Program g.t. 5 mm ac. LANDSAT	Plan 100 m - 5 mm ac. Photo/Field Rec.	Project 1.t. 100 m ac. Photo/Field Samp.
1. Individuals to single habitat variables	Pot. spp. pres. - lowest accur. - lowest cost	Pot. spp. pres. - low accuracy - low cost	Pot. spp. pres. - mod. accuracy - mod. cost
2. Capability of area for groups of individuals	Habitat Capab. - low accuracy - low cost	Habitat Capab. - mod. accuracy - mod. cost	Habitat Capab. - high accuracy - high cost
3. Population Capability of Range	Range Capacity - low accuracy - mod. cost	Range Capacity - mod. accuracy - high cost	Range Capacity - highest acc. - highest cost

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM

PROGRESS: AUGUST 1981

SPECIES NOTES AND MAPS:

Western Sierra	Field use 5/79	Published 12/80
Intermountain (NE CA)	Field use 10/80	Published 10/80
North Coast/Cascades	Field use 5/79	No publication
Southern California	Drafts 10/81	Publication 12/81
Central Coast	Contract 9/81	Publication 7/82
Entire State *	Contract 10/81	Publication 7/82 through 6/83

*Distribution maps for all species in state being digitized by CNDDB with publication target 3/82

HABITAT CAPABILITY MODELS:

Level 1 Models: same status as Species Notes

Level 2 Models:	Mammals	Birds	Herpts	Total
USFS (1st Drafts)	20	29	10	59
USFS (HEP coop.)	1	3	-	4
SCS (HEP coop.)	6	8	4	18

An unknown number remain to be drafted. All need expert review and field testing for verification.

Level 3 Models: in the "dream" stage currently

SPECIAL HABITAT CRITERIA:

Drafts available for Riparian, Hardwoods, Aspens, Meadows, and Old growth conifers. An unknown number remain to be drafted. All need expert review and field testing for verification.

POPULATION AND HABITAT MANAGEMENT GUIDELINES:

Pronghorn	Published 3/80	
Deer	Draft 1980	Publication 12/81
Bighorn	Draft 12/81	Publication 6/82
Black Bear	Draft 3/82	Publication 8/82

An unknown number remain to be drafted. They will need review and field testing for verification.

HABITAT CLASSIFICATION:

The classification for Habitat Cover Type/Stages and Specific Habitat Elements was reviewed, revised, and approved by the Interagency Wildlife Task Group in August 1981.

HABITAT INVENTORY:

The California Natural Diversity Database was reviewed and approved for use in managing data on rare wildlife elements by the Interagency Wildlife Task Group in June 1981.

HABITAT EVALUATION MEHTODS:

The Interagency Wildlife Task Group will be reviewing HEP and other methods at its October 1981, and subsequent meetings.

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM

RESEARCH

The following are some research efforts related to species-habitat relationships that are being done in California:

PROJECT	INVESTIGATOR	AGENCY
Bird communities in conifer successional stages	Verner	PSWF & RES
Small mammal communities in conifer successional stages	Williams/Verner	PSWF & RES
Wildlife in hardwoods	Barrett	UC Berkeley
Wildlife in Douglas-fir old growth	Raphael/Barrett	UC Berkeley
Spotted owls in conifer late successional stages	Laymon/Barrett Solis/Gutteirez	UC Berkeley CSU Humboldt
Marten in conifer types	Martin/Barrett	UC Berkeley
Bird communities in Douglas-fir successional stages	Marcot/Meslow	Oregon SU
Snag dependent wildlife	Raphael	UC Berkeley
Black bear in conifers	Grenfell	CDF & G
Waterfowl, pronghorn and wetlands	Salwasser	UC Berkeley

Research and monitoring the implementation of habitat evaluation system products is essential for inventory update, testing predictive models, refining species-habitat relationships models, and developing new products.

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM

EXPECTED BENEFITS

A common system and terminology for describing wildlife and fish and their interactions with habitats;

Improved habitat evaluation technology for all wildlife and fish resources in the state:

- Capability for consideration of all species, with emphasis on selected wildlife and fish resources;
- Consistent and repeatable predictions of habitat capability and management consequences for wildlife and fish;
- More habitat capability information obtained for less manpower, dollars, and time spent on assessments;

Minimization of the need for exhuastive literature and other information source searches;

More efficient and effective use of inventory data in resource management decisions;

Increased accountability for wildlife and fish consequences of resource management decisions; and

More effective direction of wildlife and fish research to meet resource management information needs.

CALIFORNIA WILDLIFE AND FISH HABITAT RELATIONSHIPS PROGRAM

GLOSSARY

Analysis: an examination of a complex, its elements, and their relations

Assessment: the act of determining the importance, size, or value

Capability: having general efficiency and ability

Classification: a systematic arrangement in groups or categories according to established criteria

Evaluation: a determination of the significance or worth of something, usually by careful appraisal and study

Inventory: an itemized list of current assets, e.g. natural resources

Monitor: to watch, observe, or check the functioning of a system

Data: factual information used as a basis for reasoning, discussion, or calculation

Database: a collection of interrelated data stored together with controlled redundancy to serve one or more applications in an optimal fashion; the data are stored so that they are independent of programs which use the data

Model: a description or analogy used to help visualize something that cannot be directly observed; a miniature representation of something

Validation: the determination of the degree of conformance with accepted principles and theory, or of relevance and meaningfulness